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LAKE TROUT

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GEOGRAGHIC DISTRIBUTION

The lake trout (Cristivomer namaycush) is principally an inhabitant of the cool and usually large lakes of the northern latitudes. In North America it ranges from Alaska to the Labrador Peninsula; its southern limit extends from northern New England through the headwater lakes of the Lake Ontario, St. Lawrence, and Hudson River systems in New York, the Great Lakes drainage basin, the lakes of the northern Mississippi River watershed in Wisconsin and Minnesota, and the headwaters of the Columbia and Fraser Rivers to the waters on Vancouver Island. The species has been widely introduced in the West. It is most abundant in the Great Lakes (although rare in Lake Erie), where extensive commercial fisheries have been developed for it from the time of the earliest settlement. More recently the so-called "deep-sea trolling" for lake trout has grown into a major sport in the Great Lakes.

HABITAT

The adult lake trout spends the greater part of the year in the deep, cool water of the inland lakes where it is found. It does not enter streams, except in certain areas in the West. In the fall it usually comes into shallow water to spawn. The depth distribution varies from lake to lake, and within each lake according to the seasons. In summer, the trout of the smaller inland lakes remain in the deepest waters.

In the Great Lakes, most of the lake trout live in waters less than 60 fathoms (360 feet) deep, although they penetrate the greatest depths that can be fished with nets (750 feet). Adult lake trout are roamers and apparently invade all levels and all depths at some time of the year. The so-called "ciscowet" or fat trout of Lake Superior seldom enters water less than 40 fathoms deep and occurs most abundantly in depths of 80 to 100 fathoms. In southern Lake Michigan, the trout prefer to live and spawn on clay bottoms in 30 to 60 fathoms, whereas in the northern part of the lake, they prefer to concentrate in the shallower water on the reefs and around the islands.

In upper Lake Michigan, there is a summer offshore movement of the trout that have been in inshore waters. In June and July these trout appear to be concentrated at depths of 60 to 80 feet, and a second concentration occurs in July in depths greater than 110 feet. In August and apparently thereafter, until they seek shallow water to spawn, the trout occur most abundantly in depths greater than 110 feet. In spring, the Green Bay trout seem to concentrate at depths of 40 to 60 feet, and thereafter become much less abundant and more nearly equally distributed in depths of 40 to 110 feet.

Seasonal changes in distribution also occur in the other Great Lakes. In southern Lake Huron, lake trout usually are scarce in summer in water less than 100 feet deep. In the East Tawas-Oscoda (Michigan) area the species is also scarce at this time in less than 100 feet of water, and the inshore population appears to shift to progressively deeper water as the season advances from July to October. In the Alpena-Ossineke (Michigan) region and perhaps farther north, the inshore trout appear to move from depths greater than 100 feet in May to a 40- to 70-foot depth range in June, and return to progressively deeper water in July (beyond 70 feet), August (beyond 90 feet), and September (beyond 120 feet).

In Lake Superior, around the Apostle Islands, it is stated that in early summer (June) the trout are on the shallower reefs in 15 to 30 feet of water, but move to depths of 60 to 120 feet in July, August, and September.

In the spring or early summer and fall, many trout rise off the bottom, at which times they are taken by certain commercial fishermen with floated hooks. Also, in the fall there is generally a pronounced movement toward shallower water for the purpose of spawning. After spawning the trout again retreat to deeper water.

EXTENT OF MIGRATIONS

Tagging experiments on Lake Michigan have shown that adult lake trout roam throughout the lake but that the vast majority of the young fish (under 1-1/2 pounds) tend to remain in their home waters (within a radius of 25 miles). It is probable that similar conditions exist in the other Great Lakes, although in Lake Superior one small tagged fish had traveled approximately 100 miles from the point of release when recaptured. An adult tagged on Lake Superior had migrated from Michigan to Minnesota, a straight-line distance of 236 miles.

GENERAL CHARACTERISTICS

Three varieties of lake trout (called also Mackinaw trout and Great Lakes trout) have been described by scientists, but because the so-called distinguishing characters (shape of head, size of fins, and fatness) overlap considerably or intergrade, it is doubtful whether these subspecies are really different. Commercial fishermen believe that many (up to 12) races exist, particularly in Lake Superior, where the fat, deep-water trout, called the ciscowet, is most abundant.

The body form of the common lake trout is extremely variable, but as a rule is moderately elongate. The length from the tip of the snout to the base of the tail fin is four to four and a half times as great as the maximum depth of the body. The tail fin is deeply notched or forked. The head, eyes, and mouth are large. The upper jaw extends backward far beyond an imaginary line drawn vertically downward from the back of the eye. The teeth on the jaws, tongue, and roof of the mouth are very strong. The imbedded scales are small and vary from 185 to 210 in number in the lateral line (horizontal row of scales bearing pores, visible along each side of the body).

No spines are present in the fins. The back fin and the anal fin behind the vent each have about 11 developed rays. The base of the latter fin is shorter than its depth (higher than long). A small fatty fin is located on the back near the tail fin.

The general color of the lake trout varies from pale gray to almost black. The body is covered with light gray or whitish spots or mottlings, but no red spots or other bright colors are present, as in many other trouts. The top of the head and back are marbled with worm-like tracings, and the anal, tail, and back fins are marked with a network of dusky lines. The lower fins, unlike those of the brook trout, are without conspicuous light edgings.

The flesh of the common lake trout has a very delicate flavor. The ciscowet or fat lake trout, however, is too fat for ordinary use and almost melts away in frying. Most of the excessively fat fish are smoked for the market. Both white-meated and red-meated lake trout occur in the Great Lakes and often in the same waters and schools. The color of the flesh was considered by the late Dr. E. E. Prince to be a matter of inheritance, correlated with a colored material in the yolk of the egg and not, as popularly believed, associated with food or environmental conditions. Red-meated trout develop from red- or orange-colored eggs and white-meated fish from pale or white eggs.

PLACES AND SEASONS OF SPAWNING

The spawning season of the lake trout begins in late September or October and ends from early October to late November or early December, varying with the latitudes, the lakes, and the races of fish. The length of the spawning season varies from about 10 days in small lakes to 40 days or more in large lakes. It is believed that successful spawning occurs normally at a falling water temperature of about 40°F.

A wide variety of spawning grounds and depths are selected by lake trout. They may spawn on open reefs or around islands, in channels and bays with mossy bottoms, in deep water on clay bottoms, or along open shores. They may spawn in water as shallow as 2 or 3 feet and as deep as 60 fathoms (360 feet). Spawning, however, occurs most commonly on reefs often with "honey comb" rock bottom in water from 6 to 120 feet in depth.

It has been computed that a female lake trout when spawning produces about 750 eggs per pound of body weight. The number deposited on the spawning grounds would perhaps average approximately 6,000 eggs per female.

In the hatcheries, lake trout eggs may hatch as early as January and as late as March or April, the incubation period varying with the water temperatures. The approximate length of the incubation period may range from 75 to 130 days at water temperatures varying from 45° to 36°F.

FEEDING HABITS

Adult lake trout are voracious and versatile feeders. Feeding habits vary with the lakes, the size of the fish, the depth of the water, and the seasons. In Lake Ontario, for example, the dominant food of the larger lake trout, in early summer, is the alewife; in Lake Opeongo, Ontario, the principal diet consists of whitefish and yellow perch; whereas in most lakes the ciscoes (chubs) or lake herrings comprise the main article of subsistence. In Lake Michigan, lake trout longer than 18 inches seldom consume invertebrates, whereas those less than 15 inches feed, to a large extent, on these forms and on the sculpins and other small fishes, such as the shiners and sticklebacks. The ciscoes or lake herrings (not whitefish) comprise the main articles of diet of the adult trout in Lake Michigan. More recently in those waters where smelt were extremely plentiful they replaced the herrings to a large extent. It is not uncommon to find lake trout feeding on the eggs of their own species. The variation in food with depth of water and seasons depends largely on the movements of the trout and the natural distribution of the food organisms involved. As the trout move into shallower waters they prey more and more on the shallow-water forms, and, with their return to greater depths, on deep-water forms.

AVERAGE SIZES IN CATCH

Next to the sturgeon, the lake trout is the largest of our fresh-water fishes. Although there is an authentic record of an 88-pound lake trout and fish of 125 pounds have been reported, not many individuals now taken weigh over 50 pounds. The average weight in the commercial catch on the Great Lakes varies with the locality, season, and gear from 3 to 10 or 12 pounds, and very few fish heavier than 25 pounds are captured by the commercial fishermen. The heavier fish are taken on or near the spawning grounds in the fall. The spawning trout average larger in northern Lake Michigan than in southern Lake Michigan, and in Lake Superior than in Lake Michigan.

The trout taken by sport trolling in Grand Traverse Bay (Lake Michigan) average about 8 pounds. On Lake Superior at Copper Harbor, Michigan, the troll-caught fish averaged 4-1/2 pounds in July and 8 pounds in August, 1941, with a grand average of 6-1/3 pounds. At Munising, Michigan, the season's

average for one camp from July to October in 1940 was 11-1/2 pounds, although the trout entered in the Munising trolling derby in 1941 averaged 14 pounds in July, 17.2 pounds in August, and 15.9 pounds for both months. Lake trout taken by anglers with hook and line other than trolling average approximately 23 inches in length and about 4-1/2 pounds in weight.

RELATION BETWEEN LENGTH AND WEIGHT

The length-weight relationship of lake trout, like growth, varies with conditions. Table 1 gives the best information available on the weight of lake trout from Lake Michigan at different lengths.

Table 1.--Length-weight relationship of lake trout from Lake Michigan

Total length	Weight		Total length	Weight
Inches	Pounds	Ounces	Inches	Pounds
10	...	6	24	4.9
11	...	7	25	5.4
12	...	9	26	5.8
13	...	11	27	6.2
14	...	13	28	7.3
15	1.0	..	29	8.4
16	1.1	..	30	9.2
17	1.3	..	31	9.8
18	1.7	..	32	11.3
19	2.1	..	33	13.2
20	2.6	..	34	14.5
21	3.2	..	35	....
22	3.8	..	36	15.5
23	4.4	..	..	....

The lengths and girths at different weights of the Lake Superior lake trout entered in the trolling derby at Munising, Michigan, in 1941 are shown in table 2. These measurements were obtained through the courtesy of Mr. Lewis Merwin, Manager, Munising Development Club. Numbers of fish used are shown in parentheses.

Table 2.--Length-weight-girth relationships of certain lake trout from Lake Superior.

Weight in pounds	Total length in inches	Girth in inches	Weight in pounds	Total length in inches	Girth in inches
5.5(7)	25.4	13.2	16.4(4)	36.6	19.9
6.1(5)	27.6	14.0	17.4(3)	37.3	20.2
6.9(4)	28.2	14.5	18.8(5)	37.8	20.8
7.6(7)	28.9	14.8	20.0(5)	38.3	21.6
8.1(4)	29.6	15.0	21.8(7)	39.9	22.0
9.1(5)	29.8	15.2	23.1(5)	40.0	24.2
10.0(6)	31.0	16.3	24.2(9)	40.7	23.9
11.4(7)	32.4	17.0	26.1(6)	41.4	23.6
12.3(7)	32.9	17.9	27.2(3)	42.0	24.0
13.4(6)	33.6	18.5	28.8(6)	42.2	23.8
14.2(6)	34.4	18.6	30.2(5)	43.6	26.0
14.9(7)	35.4	19.1	33.0)4)	41.8	25.5

AGE AND GROWTH

Very little information is available on the age and growth of wild lake trout. In Michigan, hatchery-reared trout average about 3 inches at the age of 5 months (August 1), about 8 inches at 22 months, and approximately 10 inches at an age of 2 years and 4 months. Like wild fish, hatchery fish vary in growth under different conditions.

Most recent estimates of the growth of the lake trout of Lake Michigan are shown in table 3. Since virtually no lake trout under 20 inches in length are sexually mature, and the average weight of the spawning fish is 5 pounds and more, the species must first reach sexual maturity at an age of 7 years or older.

Table 3.--Estimated lengths, weights, and growth rates of lake trout from Lake Michigan for each year of life.

Year of life	Total length (inches)	Weight (pounds)	Growth increments	
			Length (inches)	Weight (pounds)
1	5.0	-	5.0	-
2	7.0	-	2.0	-
3	9.0	-	2.0	-
4	12.5	0.6	3.5	-
5	14.5	0.9	2.5	0.3
6	18.0	1.7	3.5	0.8
7	21.5	2.8	3.5	1.1
8	24.2	4.1	2.7	1.3
9	25.8	5.3	1.6	1.2

The estimates of growth reveal an unexpectedly slow rate during the second and third years of life. Since the averages for these years are based on very small numbers of fish they may have to be revised when more adequate information becomes available. The averages for trout older than 4 years were obtained by the addition of known annual increments of growth of tagged fish to the estimated average of 12-1/2 inches of the four-year individuals. If a 12-1/2-inch fish is only 3 years old, then the estimates of age of the older fish are all one year too high.

The relatively few data available indicate that the growth of adult lake trout of the same age varies tremendously with the individuals. This great variation is perhaps associated largely with the tendencies of the fish to travel alone and feed by themselves. Some individuals would be more fortunate than others in obtaining food, and there would then result a marked difference in growth. Differences among individuals of a species that moves in schools would be much less pronounced. The large size of an individual lake trout, therefore, is not always indicative of old age.

The ages of a few relatively old or heavy lake trout from scattered localities have been determined. The fish are listed in table 4 with their weight or length. The oldest fish was in its fourteenth year (XIII); the heaviest weighed 43 pounds and measured 45 inches in length. The oldest lake trout on record was 20 years (not shown).

Table 4.--Ages and weights of certain lake trout from various localities

Weight in pounds	Total length in inches	Age in years (number of year-rings on scales)	Locality of capture
4.1	24	IX	Lake Michigan (Charlevoix)
6.4	26 1/4	IX	Lake Michigan (Charlevoix)
9.25	27	VII	Seneca Lake, New York
....	29	XI	Sea Gull Lake, Minnesota
....	32	IX	Lake Superior (Minnesota)
11.5	33	XI	Lake Michigan (Charlevoix)
11.75	..	VIII	Fremont Lakes, Wyoming
17.0	34	XII	Seneca Lake, New York
17.1	36	IX	Grindstone Lake, Minnesota
29.0	..	XIII	Lake Superior
35.0	44	XIII	Lake Michigan (Two Rivers)
43.0	45	XIII	Lake Michigan (Port Washington)

METHODS OF FISHING

Trolling

Although trolling for lake trout has only recently captured the interest of a large number of sportsmen on the Great Lakes, the sport is in reality an old one. In his book, "The Fishing Tourist," published in 1873, Charles Hallock reported that none of the various species of lake trout were considered game fish as they seldom rose to a fly, although they afforded good sport for trolling. In early days, many commercial fishermen of the Great Lakes trolled for lake trout for the market.

The present development of trolling for sport on the Great Lakes had its origin in 1928 on Grand Traverse Bay in the northeastern part of Lake Michigan, although recent trolling for commercial purposes was initiated in 1926 at Munising, Michigan, on Lake Superior. From Grand Traverse Bay the sport spread to other areas on Lake Michigan but particularly to the southern and Minnesota shores of Lake Superior. There it expanded rapidly and became established at nearly every fishing port or locality where suitable harbor facilities were available and within reasonable distance of lake trout fishing grounds.

Cabin cruisers and renovated fishing tugs equipped with chairs, large reels, heavy rods, metal line, and copper, nickel, brass, silver, or pearl spoons are used. Number 5-0 and 6-0 hooks are preferred. Parties up to a dozen persons can be accommodated on many of the boats, although the average size of a party is about four persons. Trolling is usually done just off the bottom of the banks or reefs frequented by lake trout while the boat moves about 3 miles an hour. From 150 up to 2,000 feet of line are let out, the amount depending on the depth of water fished. Nearly all of the trolling for sport is conducted between the last week in May and the closed season for lake trout early in October.

Bobbing

Bobbing or fishing for trout through the ice has perhaps reached its greatest development on Lake Superior. The fisherman provides himself with a hand sled, a canvas or burlap windbreak, one or two poles, a small stool or box, an ice chisel, a heavy bobbing line (breaking strength from 60 to 90 pounds) treated with pine tar, coal tar, and paraffine, and then stretched, a flat 8-ounce sinker, heavy hooks (size 8-0 or 10-0) with a wide band, and bait or "bobber" which consists of flat, elongated pieces of herring. The hook is attached to a leather trace which is strung through the two eyes of the sinker. The bait is attached to the hook in such manner that it simulates a live fish when the line is jerked or bobbed up and down. In Lake Superior, bobbing usually is done in 75 to 100 feet of water. It begins in protected waters about mid-January and on the open waters early in February and continues into April. A careful watch must be kept of the offshore winds which move the ice fields away from shore.

COMMERCIAL PRODUCTION AND ABUNDANCE ON THE GREAT LAKES

With the rapid expansion of trolling on the Great Lakes, sportsmen must now be taking tens of thousands of pounds of lake trout from these waters. We have no complete record of this catch, although it is known that at one camp the sportsmen took an average of 18,700 pounds per season during the period from 1938 to 1941.

We have, however, records of the catches made by the commercial fishermen of the Great Lakes. In 1942 the lake trout production amounted to about 14-1/2 million pounds. Of this total some 4-1/3 million pounds came from Canadian waters (Province of Ontario) and nearly 10-1/5 million pounds from the United States. The United States catch brought the fishermen $2,425,050. More than 5-1/3 million pounds came from the State of Michigan, 3-1/3 million pounds from Wisconsin, and 1-1/10 million pounds from Illinois. The other States, except Ohio and Pennsylvania which took none, produced smaller quantities. The United States fishermen of Lake Michigan took nearly 6-1/2 million pounds, of Lake Superior 3 million pounds, and of Lake Huron 3/4 million. Only 3,200 pounds came from the United States waters of Lakes Erie and Ontario.

Some lake trout are taken in all types of commercial gear used by United States fishermen on the Great Lakes. However, the bulk or about 75 per cent of the production is caught in gill nets. Some 20 per cent is taken on set hooks, 3 per cent in pound nets, and the remaining 2 per cent in trap nets, fyke nets, seines, and on trolling lines, the only other kinds of gear employed on the Great Lakes.

In none of the Great Lakes are lake trout as plentiful today as they were in the earlier years. Compared with the periods of maximum production by crude nets in the early days, the recent average annual yields of the United States waters, stated in percentages of the early yields, are as follows: Lake Ontario, 67; Lake Erie, 1; Lake Huron, 48; Lake Michigan, 67; and Lake Superior, 66. On the whole, the present-day catch is about two-thirds that of the earlier years, notwithstanding the vast improvement in fishing equipment, the exploitation of new grounds, and the general increase in fishing intensity.